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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/734,905	12/12/2003	Yean-Yow Hwang	15114-067400US	2440

26059 7590 03/11/2005

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EXAMINER

LIN, SUN J

ART UNIT

PAPER NUMBER

2825

DATE MAILED: 03/11/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/734,905

Applicant(s)

HWANG ET AL.

Examiner

Sun J. Lin

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 12 December 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 6-15 is/are rejected.
- 7) ☒ Claim(s) 5 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 December 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>12/12/03</u> . | 6) <input type="checkbox"/> Other: _____  |

### DETAILED ACTION

1. This office action is in response to application 10/734,905 filed on 12/12/2003. Claims 1 – 15 remain pending in the application.

### *Specification Objections*

2. The specification is objected to because of following informalities:

Page 4, line 3, change "figure 1A" to —**Figure 1A**—.

Page 4, line 14, change "figure 7" to —**Figure 7**—.

Page 4, line 18, change "figure 9" to —**Figure 9**—.

Page 4, line 21, change "figure 11" to —**Figure 11**—.

Page 4, line 23, change "figure 11" to —**Figure 11**—.

Page 4, line 24, change "figure 13" to —**Figure 13**—.

Page 4, line 29, change "figure 1A" to —**Figure 1A**—.

Page 5, line 9, change "figure 1B" to —**Figure 1B**—.

Page 5, line 10, change "figure 1A" to —**Figure 1A**—.

Page 6, line 14, after "which" delete —**the system**—.

Page 6, line 26, change "figure 1C" to —**Figure 1C**—.

Page 7, line 16, change "figure 1" to —**Figure 1**—.

Page 8, line 3, change "figure 2" to —**Figure 2**—.

Page 8, line 12, change "figure 2" to —**Figure 2**—.

Page 8, line 24, change "figure 2" to —**Figure 2**—.

Page 9, line 13, change "figure 4" to —**Figure 4**—.

Page 9, line 27, change "figure 1" to —**Figure 1**—.

Page 13, line 19, change "figure 5" to —**Figure 5**—.

Page 14, line 1, change "figure 5" to —**Figure 5**—.

Page 14, line 23, change "the a" to —**a**—.

Page 14, line 25, change "figure 6" to —**Figure 6**—.

Page 14, line 27, change "figure 5" to —**Figure 5**—.

Page 14, line 28, change "figure 5" to —**Figure 5**—.

Page 14, line 30, change "figure 5" to —**Figure 5**—.

Page 15, line 26, change "figure 8" to —**Figure 8**—.

Page 16, line 1, change "figure 7" to —**Figure 7**—.

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Page 16, line 2, change "figure 10" to **—Figure 10—**.

Page 16, line 5, change "figure 11" to **—Figure 11—**.

Page 16, line 7, change "figure 11" to **—Figure 11—**.

Page 16, line 8, change "figure 14" to **—Figure 14—**.

Page 16, line 9, change "figure 12" to **—Figure 12—**.

Page 16, line 20, change "figure 7" to **—Figure 7—**.

Page 17, line 6, change "figure 6" to **—Figure 6—**.

Appropriate correction is required.

### ***Drawing Objections***

3. Drawings are objected to because of following informalities:

Fig. 2 should be labeled as a **—(PRIOR ART)—**.

Fig. 3 should be labeled as a **—(PRIOR ART)—**.

Fig. 4 should be labeled as a **—(PRIOR ART)—**.

Fig. 7 should be labeled as a **—(PRIOR ART)—**.

Fig. 9 should be labeled as a **—(PRIOR ART)—**.

Fig. 11 should be labeled as a **—(PRIOR ART)—**.

Fig. 13 should be labeled as a **—(PRIOR ART)—**.

Appropriate correction is required.

### ***Claim Objections***

4. Claims listed below are objected to because of the following informalities:

Claim 1, line 15, change "second" to **—selected—**.

Claim 7, line 2, after "done" insert **—on—**.

Claim 8, line 2, after "method" insert **—of logic synthesis—**.

Claim 8, line 5, change "the first or second alternative netlists" to **—the first alternative netlist or the second alternative netlist—**.

Claim 8, line 6, change "the first and second alternative netlists" to **—the first alternative netlist and the second alternative netlist—**.

Claim 11, line 1 – 2, change "the first or second alternative netlists" to **—the first alternative netlist or the second alternative netlist—**.

Claim 12, line 1 – 2, change “the first or second alternative netlists” to **—the first alternative netlist or the second alternative netlist—**.

Claim 13, line 2, after “method” insert **—of logic synthesis—**.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

- (1). Determining the scope and contents of the prior art.
- (2). Ascertaining the differences between the prior art and the claims at issue.
- (3). Resolving the level of ordinary skill in the pertinent art.
- (4). Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claims 1 – 4, 6, 7 and 13 – 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,594,657 to Cantone et al. in view of IEEE Paper entitled “On Area/Depth” Trade-Off in LUT-Based FPGA Technology Mapping” authored by Cong & Ding.

7. As to Claim 1, Cantone et al. show and teach the following subject matter:

- Computer aided design (CAD) system for implementation of FPGA – [col. 1, line 11 – 18; Fig. 1];
- User entering (i.e., providing) CAD system a High-level application netlist language (i.e., high-level design language) description of a (logic) circuit – [col. 3, line 15 – 25]; High level circuit description – [abstract]; specifying a Boolean function (i.e., logic function) using Boolean equation (i.e., high-level design language) – [col. 14, line 20 – 25]; logical gate – [col. 14, line 38]; Notice that (1)

a logic circuit can be described by a logic function (Boolean function) using a Boolean equation (high-level design language) (2) the logic function can be synthesized using logic gates including AND, OR, INV, NAND, NOR etc.

Cantone et al. do not teach (1) synthesizing logic gates to respectively obtain a first alternative netlist and a second alternative netlist for the logic function, (2) performing a technology mapping of the first alternative netlist to obtain a first mapping netlist and performing a technology mapping of the second alternative netlist to obtain a second mapping netlist (3) selecting one of the corresponding first mapping netlist or second mapping netlist based on design criteria. But Cong & Ding teach depth-optimal mapping and area-minimizing mapping of a Boolean circuit using lookup-table (LUT) based FPGA technology mapping – [title; abstract].

Cong & Ding show and teach the following subject matter:

- Synthesizing logic gates (i.e., NAND and NOR) to obtain a first alternative netlist for a logic circuit, which can be expressed by a logic function – [Fig. 2(a)]; Notice that the depth of the first alternative netlist is 7;
- Performing depth-optimal technology mapping of the first alternative netlist to obtain a depth-optimal mapping solution (i.e., first mapping netlist) of depth 2, using 6 LUT's – [Fig. 2(b)];
- Synthesizing logic gates (i.e., NAND and NOR) to obtain a second alternative netlist for the same logic circuit; Notice that (1) for current study, the gate configuration of the second alternative netlist is the same as that of the first alternative netlist (2) the gate configurations of the first alternative netlist and the second alternative netlist can be different if structural gate decomposition is applied;
- Performing area-optimal technology mapping of the second alternative netlist to obtain an area-optimal mapping solution (i.e., second mapping netlist) of depth 5, using 6 LUT's – [Fig. 2(b)];
- Good/optimal mapping solutions under different optimization objectives (i.e., design criteria) – [page 137, right column].

Notice that selection of the first mapping netlist (depth-optimal mapping solution) or area-optimal mapping solution is based on design criteria (i.e., depth-optimal objective or area-optimal objective) of the logic circuit. Cong & Ding also teach that, using graphical representations, a set of visible mapping solutions for a given (logic) design can be obtained in order to select a mapping option to meet various area and depth requirements – [page 138, first paragraph on left column].

Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to have applied the teachings of Cong & Ding in utilizing graphical representations to generate a set of visible mapping solutions for a given (logic) design in order to select a mapping option to meet various area and depth requirements thereby achieving a selected mapping netlist.

In addition, Cong & Ding also teach the following subject matter:

- Re-mapping for area minimization – [page 138, left col., second paragraph]; area/depth trade off in LUT-based FPGA technology mapping – [title]; Notice that the (1) Re-mapping can also be applied for depth minimization (2) re-mapping, area/depth trade off is applied for optimizing the selected mapping netlist;
- After optimizing, performing a technology mapping, using RAM memory to realize each LUT, on the selected mapping netlist – [col. 18, line 59 – 67].

For reference purposes, the explanations given above in response to Claim 1 are called **[Response A]** hereinafter.

8. As to Claims 2 and 3, reasons are included in **[Response A]** given above. Notice that depth-optimal mapping is equivalent to delay-optimal mapping; optimizing delay is achieved by optimizing depth.

9. As to Claim 4, reasons are included in **[Response A]** given above. The first mapping netlist shown in Fig. 2(b) comprises LUT structures, whose logic functions are represented by a set of logic blocks made of logic gates.

10. As to Claim 6, reasons are included in [Response A] given above. The first alternative netlist shown in Fig. 2(b) comprises logic gates.

11. As to Claim 7, reasons are included in [Response A] given above.

12. As to Claim 13, reasons are included in [Response A] given above. Notice the following:

- a netlist  $\Leftrightarrow$  a first alternative netlist or a second alternative netlist;
- a first technology mapping  $\Leftrightarrow$  a depth-optimal technology mapping or a area-optimal technology mapping of netlist into gate array blocks, which are to be implemented using LUT's;
- a synthesis optimization  $\Leftrightarrow$  area/depth trade-off on the netlist;
- a second technology mapping  $\Leftrightarrow$  LUT realization of gate array blocks using RAM memory.

13. As to Claim 14, the first technology mapping maps the netlist to a LUT-based FPFA, which is the same target technology (LUT-based FPGA) as the second technology mapping.

14. As to Claim 15, reasons are included in [Response A] given above.

15. Claims 8 – 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,594,657 to Cantone et al. and of IEEE Paper entitled "On Area/Depth" Trade-Off in LUT-Based FPGA Technology Mapping" authored by Cong & Ding in view of IEEE Paper entitled "Structural Gate Decomposition for Depth-Optimal Technology Mapping in LUT-Based FPGA Designs" authored by Cong & Hwang.

16. As to Claim 8, Cantone et al. and Cong & Ding show and teach the subject matter as explained in [Response A] given above, with the following equivalences: :

- generating a first alternative netlist for a logic function  $\Leftrightarrow$  synthesizing a first alternative netlist (e.g., depth-optimal LUT-based netlist) for a logic function;
- generating a second alternative netlist for the logic function  $\Leftrightarrow$  synthesizing a second alternative netlist (e.g., area-optimal LUT-based netlist) for the logic function;

- Selecting one of the first alternative netlist or the second alternative netlist as a selective alternative netlist based on results of a technology mapping (i.e., LUT-based technology mapping) of the first alternative netlist and the second alternative netlist – [Response A; Cong & Ding: Fig. 2].

Cantone et al. and Cong & Ding do not teach that gate configuration of the second alternative netlist is different from that of the first alternative netlist. But Cong & Hwang teach structural gate decomposition for depth-optimal technology mapping in LUT-based FPGA designs – [title; abstract]. Notice that the structural gate decomposition is applied to change the gate structure of a given logic circuit. Cong & Hwang also teach that structural gate decomposition is performed on netlist of a logic circuit in order to allow mapping algorithms to obtain the smallest mapping depth – [page 196, second paragraph].

Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to have applied the teachings of Cong & Hwang in performing structural gate decomposition on the first alternative netlist of the logic circuit under study in order to allow mapping algorithms being utilized thereby achieving the smallest mapping depth.

Notice that, when the structural gate decomposition is performed on the first alternative netlist, the gate configuration of the first alternative netlist is different from that of the second alternative netlist.

For reference purposes, the explanations given above in response to Claim 8 are called [Response B] hereinafter.

17. As to Claim 9, reasons are included in [Response A] given above. As explained in [Response A], depth-area trade-off is performed by re-mapping a netlist for optimization; it is applied to perform a synthesis optimization on the selected alternative netlist to obtain an optimized selected alternative netlist.

For reference purposes, the explanations given above in response to Claim 9 are called [Response C] hereinafter.

18. As to Claim 10, reasons are included in [Response A], [Response B] and [Response C] given above. Notice that a technology mapping

19. As to Claims 11 and 12, reasons are included in [Response A] and [Response B] given above.

***Allowable Subject Matter***

20. Claim 5 is objected to as being dependent upon a rejected base claim, but it would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 5 is allowed is because the prior art does not teach or fairly suggest the following subject matter:

- A method of computer aided design comprising performing a *technology mapping* of a *first alternative netlist* to obtain a *first mapping netlist*, which comprises *digital signal processing blocks* in combination with other limitations as recited in Claim 1.

***Conclusion***

21. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sun J Lin whose telephone number is (571) 272 - 1899. The examiner can normally be reached on Monday-Friday 9:30AM - 6:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S Smith can be reached on (571) 272 - 1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Sun James Lin  
Patent Examiner  
Art Unit 2825  
March 7, 2005

